EPA

MRID NUMBER

409253-01

STUDY TITLE

Efficacy Evaluations of Two Formulations of Abamectin (Avert™) for the Control of German Cockroach Infestations in Public Housing

DATA REQUIREMENT

Guideline 158.60

AUTHOR

G. W. Bennett and B. L. Reid

STUDY COMPLETED ON:

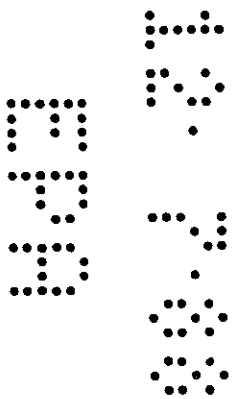
September 21, 1988

PERFORMING INSTITUTION

Purdue University
Department of Entomology
Entomology Hall
West Lafayette, IN 47907

PRODUCT ID

WRL-310EF2



STATEMENT OF NO CONFIDENTIALITY CLAIMS

No claim of confidentiality is made for any information contained in this study on the basis of its falling within the scope of FIFRA 10(d)(1)(A), (B) or (C).

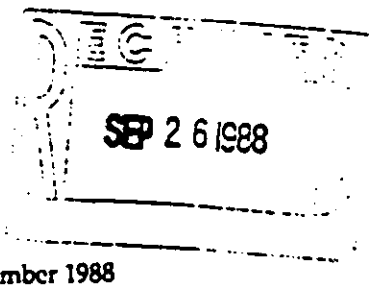
Company: Whitmire Research Laboratories, Inc.

Company Agent: Michael G. Sarli Date: November 9, 1988

Title: Manager, Regulatory Affairs

Signature

PURDUE UNIVERSITY



21 September 1988

DEPARTMENT OF ENTOMOLOGY

Mr. Jonathon Berger
Whitmire Research Labs.
3568 Tree Court Industrial Blvd.
St. Louis, MO 63122

Dear Jonathon:

I am sending the formal reporting from our field trial with this correspondence. I wanted you to know that the Whitmire trials were the only ones still providing adequate control after the three months of the summer program, all the pyrethroids had failed by 3 months. This is a testament to the effectiveness of the product. The people receiving your product were equally pleased by the results and seemed genuinely sorry to see us go.

I want to express my appreciation for all your help throughout the course of this summer project and look forward to working with you again in the future. The use of the aerosol cans during our final post-count/clean-out of the pyrethroid study was very helpful, perhaps we could discuss acquisition of additional aerosolized bait for the pretreatment survey upon initiation of next summers field trials.

We will be including these results in a submission for the 1989 issue of Insecti. Acari. Tests later this fall. Please call me if this is a problem.

If you have any questions, don't hesitate to give me a call; (317) 494-6314.

Sincerely,

Byron L. Reid
Research Associate

enclosures
cc/ G.W. Bennett

PURDUE UNIVERSITY
RESEARCH REPORT

Efficacy Evaluations of Two Formulations of abamectin (Avert®) for the Control of German cockroach Infestations in Public Housing

G. W. Bennett and B. L. Reid
September 1988

Personal privacy information

Purpose

Field trials were conducted to determine comparative efficacy and residual persistence of control from two bait formulations of the neurotoxin abamectin (avermectin B1a; Avert®). The two forms of abamectin tested were a dry, 'dust-bait' which contained 0.05% a.i., and a 0.01% a.i. aerosolized bait product.

Materials and Methods

This research project was carried out in the [redacted] a multi-family, public housing facility provided by the Gary (Ind.) Housing Authority. The building construction practices and generally poor sanitary conditions in this test site favored development of some very high cockroach populations, making for tough test conditions. Each individual apartment in any building served as the replicated, experimental unit.

Cockroach population levels in each apartment were estimated by a team of two researchers at periodic intervals throughout the three months of this study. Visual counts were used as the sampling method, and each researcher was aided by a flashlight and mirror. For estimating efficacy, the kitchen and immediate vicinity, the upstairs linen closet, the living room closet and the bathroom(s) were the only areas sampled. In each sampling area, the number of cockroaches in the general (visable) area were first counted, then the numbers within each specialized harborage were counted. All data was recorded, by location, on a standard data sheet (see Appendix). These visual counting procedures provide a *relative estimate* of the population size with which to evaluate changes in the population density following treatment with the insecticidal baits, and for comparisons between the two bait formulations.

A minimum visual precount of 20 cockroaches was required for any apartment to be considered as a test. If a precount was less than 20, the apartment's resident was given Combat® cockroach baits, and this apartment was not considered for further testing. This resulted in all apartments in the complex receiving some kind of treatment, whether they are used as a test site or not. Initially, 16 (dry formulation) or 15 (aerosol formulation) apartments were established for the treatments in the comparison. However, this sample size varied from postcount to postcount since there occasionally was an apartment vacancy or a lack of tenant cooperation in the test apartments.

While the population estimates were taken only from the kitchen and the bathroom areas, the entire apartment received the bait treatments. Bait product placement was pervasive throughout the test apartments. In the kitchen area, the bait was placed under the kitchen sink, in the corners and wall intersections near the stove and refrigerator, beneath major appliances, and behind (and to a lesser extent inside) of cabinet shelves; in the bathroom, behind the toilet, and in a cabinet beneath the sink. Additionally, bait was distributed in the living room, closets and bedrooms in corners and wall intersections and inside many pieces of furniture, such as dressers and free standing cabinets. No attempt was made to rigidly control the amount of bait applied within an apartment; the extent of the infestation and the amount of cockroach harborage needing treatment dictated the amounts of bait applied. However, the exact amount of bait applied in each apartment was determined for subsequent analysis.

Statistical analysis of the efficacy for these bait treatments was accomplished using Analysis of Variance models, followed by Newman-Keuls multiple comparison test ($p = 0.05$) to make comparisons among treatments. To insure uniformity of test conditions between the two treatments being compared, the mean pretreatment visual estimate of cockroach density was compared. The pretreatment density estimates were analyzed as the raw, untransformed data.

To evaluate insecticidal efficacy, two different approaches were taken. First, the mean percent reduction was compared among the treatments

independently at each posttreatment evaluation interval. This test establishes whether one treatment was performing better than another. Secondly, for each treatment, the percent reduction in pretreatment density was compared among all posttreatment evaluation intervals. This test establishes whether the reductions were significant (i.e - baits caused reductions from the pretreatment cockroach density) and whether these reductions changed throughout the time course of the study. Prior to statistical analysis, percent reduction data are transformed to satisfy the ANOVA assumptions for normal distribution of data and equality of variance. Negative percent reductions were converted to zero, and ANOVA was performed on the arcsine ($\sqrt{p}$) transformed data.

Results and Discussion

In the appendix to this report, the results from each individual apartment under study are presented as both the actual numbers counted and the percent reductions from the pretreatment visual counts. Also, measures of the amount of formulation applied in each apartment are presented in separate appendices. The population reduction results are summarized for discussion in Table 1, and in Figure 1 a graphical presentation of the results is provided.

Applications of the 0.05% a.i. dry formulation of abamectin averaged 38.8 g per apartment (range: 18.9 to 49.7), while applications of the 0.01% aerosol formulation averaged 543.0 g (range: 250.3 to 818.5). When converting the amount of bait applied to the actual amount active ingredient applied, it can be shown that with the dry formulation an average of 19.4 mg of abamectin were introduced to the treated apartments, while with the aerosol formulation an average of 54.3 mg was applied. This difference, when analyzed, was shown to be highly significantly different (Student's t-test, $t = 17.13$, 14 df, $p < 0.0001$). In these tests, the aerosol formulation received more than twice the amount of abamectin in test apartments than did the dry formulation's test apartments.

The average pretreatment population density (over all 3' apartments in the study) was 82.6 (± 80.7, std.dev.) cockroaches per apartment (range: 22 to 334). The average precount for apartments treated with either the dry or aerosol formulations of abamectin were 87.9 and 77.1, respectively. Statistical analysis showed no significant differences between the pretreatment infestations in these two groups of apartments (Table 1 - Part 1).

Results of the statistical analysis comparing the percent reductions in these infestations following application of the two formulations reveal that both products performed equally well for an 8 wk period (Table 1 - Part 1). Initial population reductions of 76.1% (dry form) and 86.1% (aerosol form) one week following application were not significantly different. Population reductions detected at 2, 4 and 8 wk post-treatment also were not significantly different.

Examinations of the residual efficacy of the two treatments (Table 1 - Part 2) revealed that both treatments caused the cockroach infestations to be significantly reduced relative to the pretreatment conditions. The reductions achieved by the aerosol formulation were not significantly different from each other at any of the posttreatment evaluations, indicating a consistent level of control throughout the 3 months of study. The population reduction achieved by the dry formulation at 1 wk (76.1%) was significantly lower than the reductions recorded at the 2, 4 and 8 wk evaluations, indicating that the dry formulation acted more slowly than the aerosol formulation in causing population reductions. Similarly, the the decrease in population reductions recorded for the dry form at the 12 wk evaluation indicates the treated populations were beginning to recover from the treatment.

An observation related to the above findings was found in the analysis of population reductions between the two formulations at the 12 wk evaluation. The average population reduction for the dry form had declined to 72.9%, and this was shown to be significantly lower than the average reduction for the aerosol form which was 93.3%. This result implies that the aerosol form was more effective 12 wk after treatment, which agrees with the above finding that the efficacy of the dry form had declined at the 12 wk evaluation. Both of these

results may not be surprising considering that twice as much active ingredient was introduced to the apartments treated with the aerosol formulation. This disparity would have caused the dry form treatments to have been slower acting, and to have less residual efficacy, than the aerosol form. However, there may be another possible explanation for the 12 wk data.

During the 12 wk inspection it was learned that, in response to resident complaints, some apartments had been sprayed by the exterminator under contract with the Housing Authority. One apartment in the aerosol form group, [redacted] was sprayed, thus, no count was made for the 12 wk interval. Additionally, the resident of [redacted] another aerosol form apartment, was not at home and no count was made. Both these apartments were experiencing a recovery of the cockroach populations (as determined by the preceding 8 wk evaluation). The absence of their data from the aerosol group caused the level of population reductions to be elevated above what it would have been had these two 12 wk counts been recovered.

No matter which explanation for the separation in efficacy between the two treatments at the 12 wk evaluation is truly causal, an additional factor was very clear in this study. Qualitative observations were made on the sanitation conditions in test apartments during the pretreatment visual counts. Of particular interest was the presence of grease deposits and scattered food particles which would provide the insect populations an alternate food source, which presumably would have the effect of diluting the efficacy of the bait treatments. A tabular summary is presented below:

DRY FORM AEROSOL FORM

[redacted]

With a few exceptions, these apartments demonstrated consistently poor population reductions relative to other apartments. For the most part, if an apartment was reasonably clean, the level of population reductions caused by both formulations of abamectin was very high.

Personal privacy information

Summary and Conclusions

1) Both formulations of abamectin proved to be highly effective in controlling German cockroach infestations in the multi-family, public housing units utilized in this testing program. Population reductions of 90% or better are rarely achieved under our testing circumstances, and both formulations achieved this superior level of control and maintained it for up to 2 months.

2) However, at the three month evaluations there was evidence that in some apartments the cockroach populations were recovering from the insecticidal bait treatments in both apartments treated with the dry form or the aerosol form of abamectin. These apartments typically had poor sanitation with ample food supplies to support the recovery, and presumably competed with the bait left within the apartment.

3) Though some statistical differences were established between the two formulations in their residual efficacy, these differences were not substantial and probably reflect other factors than simple formulation differences themselves. Differences in the amount of abamectin applied for the two treatments, and complications in the recovery of data from certain apartments at the 12 wk evaluations combined to give the impression that the dry formulation was less effective than the aerosol formulation. It is our opinion that such a statement cannot be soundly concluded from this study given the conditions which existed.

4) To better understand whether there are significant differences in the activity of these two formulations, field trials which had strict controls on the amount of material applied would need to be conducted. The amount of abamectin introduced to each apartment would need to be regulated so that an equal level of toxicant could be achieved between the two formulations. In this manner, clearer inferences could be drawn on potential difference in the activity of a dry, 'dust-bait' formulation and an aerosolized bait formulation.

Table 1: Evaluation of the Efficacy of Avert® insecticidal bait applied for German cockroach Control in Gary (Ind.) Public Housing - 1988.

PART 1: Analysis of Comparative Efficacy Using Visual Counting Procedures[1]

Treatment	g of bait applied	No. of Apts	Pretreatment density[2]	% reductions in visual counts at:[3] 1 wk	2 wk	4 wk	8 wk	12 wk
dry bait form (0.05% AI, abamectin)	38.8	16	87.9 (87.8)[a]	76.1[a]	92.1[a]	94.7[a]	88.0[a]	72.9[b]
aerosol form (0.01% AI, abamectin)	543.0	15	77.1 (75.2)[a]	86.1[a]	94.6[a]	93.6[a]	90.0[a]	93.3[a]

1 -Within each column, mean pretreatment densities and percent reductions followed by the same letter were not significantly different (Student-Newman-Kuels multiple range test, $p > 0.05$).

2 - Data presented are mean (std.dev.).

3 - Data presented are the mean % reduction based on pretreatment counts.

PART 2: Analysis of Residual Efficacy Using Visual Counting Procedures[1]

Treatment	No. of Apts	% reductions in visual counts at:[3] 0 wk[2]	1 wk	2 wk	4 wk	8 wk	12 wk
dry bait form	16	0.0[c]	76.1[b]	92.1[a]	94.7[a]	88.0[a]	72.9[b]
aerosol form	15	0.0[b]	86.1[a]	94.6[a]	93.6[a]	90.0[a]	93.3[a]

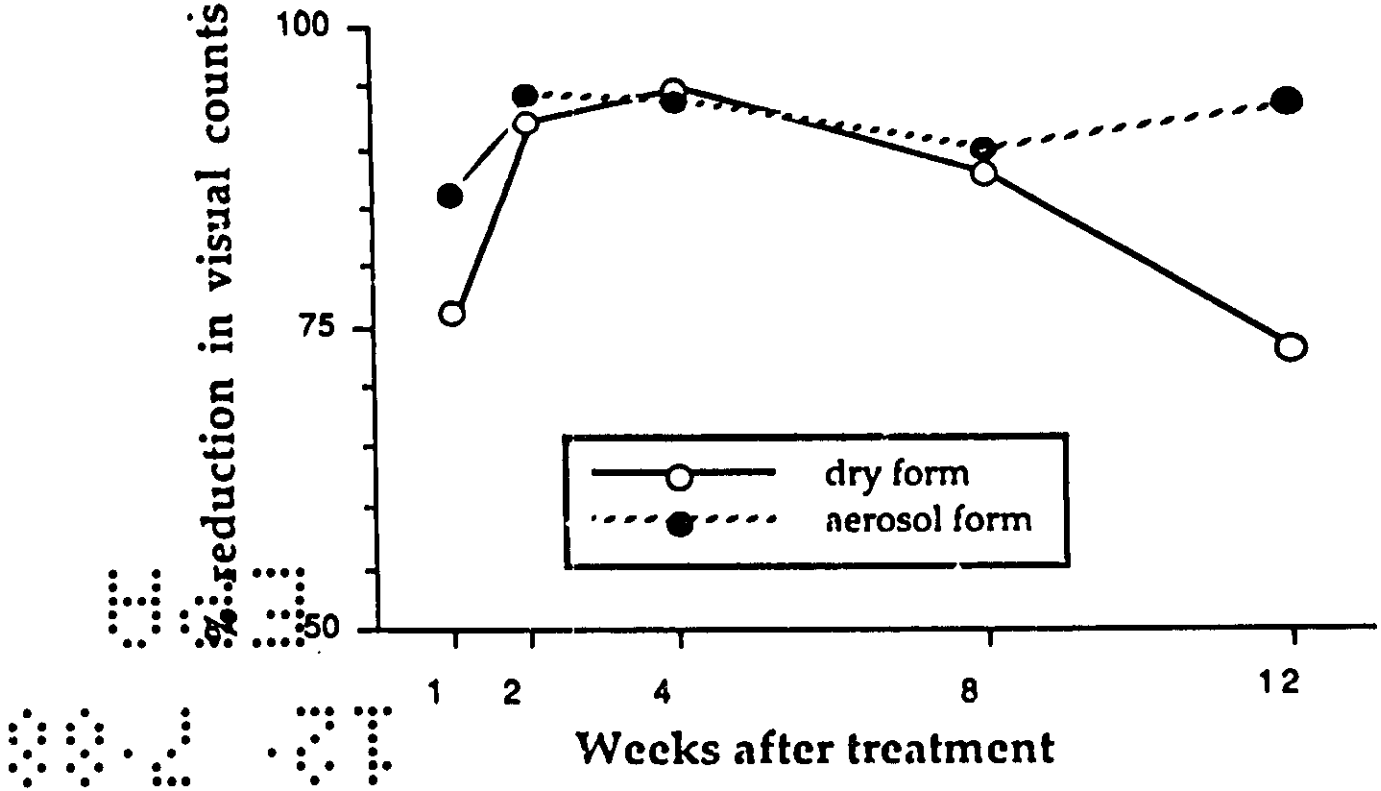
1 -Within each row, mean percent reductions in visual counts followed by the same letter were not significantly different (Student-Newman-Kuels multiple range test, $p > 0.05$).

2 - For analysis purposes, post-treatment reductions are compared to pretreatment sample reductions which by definition are set equal to 0.0.

3 - Data presented are the mean % reduction based on pretreatment counts.

Avert® efficacy in Gary field trials - 1988

Figure 1: Percent reductions in visually estimated population size following applications of one of two formulations of abamectin.



Appendices

I. Typical data sheet from the field trials

II. Summary sheets of the apartment by apartment reductions in visual counts and percent reductions in visual counts.

III. Summary of the amount of bait applied in the test apartments.

Personal privacy information

Address [redacted] Complex [redacted]

Insecticide Abate dry Date treated(retreated) 6-9-88(_____)

Researcher's Initials	[illegible]	6-16	6d23	7-6		
Date (month/day)	6/6/88	~~6/15~~ HM	NM GL	GL HM		
Room & item	Precount	1st post count	2nd post count	3rd post count	4th post count	5th post count
Kitchen	5	2	1	3		
Cab. under	150+	29	23	20		
Cab. above	60+	17	13	0		
Cab. sink/stove	—	—	—	—		
Stove	3	ON		0		
Refrigerator	2	2		0		
Utility room	35	10	0	3		
Pantry/storage closet	0	1	5	5		
Table	5+	1	5	3		
Bathroom (behind door)	20+	1	0	6		
Medicine cab.	—					
~~Linen closet (towels)~~ under sink, especially facia board	15+	6	13	7		
Total counts	295+	69	60	47		

VACATED

Comments: _____

Whitmire's Avert® (abamectin) efficacy studies - Purdue Urban and Industrial Entomology Research Program

AVERT®
dry form

ADDRESS	Pretreatment	TOTAL 1 wk	VISUAL 2 wk	COUNT 4 wk	DATA 8 wk	12 wk
[redacted]	84	13	0	0	0	0
	34	1	0	0	0	4
	99	64	35	not home	1	not home
	48	9	vacated			
	312	30	evicted			
	22	5	0	0	7	0
	295	69	60	47	vacated	
	31	5	1	3	0	20
	27	10	1	3	2	5
	60	17	11	13	11	19
	27	21	3	0	12	10
	73	16	not home	not home	4	32
	65	12	2	2	16	45
	53	1	0	1	0	6
	92	13	4	0	16	9
	84	8	3	0	5	not home
AVERAGE	87.88	18.38	9.23	5.75	5.69	13.64
STD.DEV.	87.76	20.20	17.98	13.50	6.13	14.22

All apartments treated in this study are from the [redacted] operated by Gary Public Housing

Personal privacy information

Whitmire's Avert® (abamectin) efficacy studies - Purdue Urban and Industrial Entomology Research Program

AVERT®
dry form

ADDRESS	% REDUCTION IN VISUAL COUNTS				
	1 wk	2 wk	4 wk	8 wk	12 wk
[redacted]	84.52	100.00	100.00	100.00	100.00
	97.06	100.00	100.00	100.00	88.24
	35.35	64.65	not home	98.99	not home
	81.25	vacated			
	90.38	evicted			
	77.27	100.00	100.00	68.18	100.00
	76.61	79.66	84.07	vacated	
	83.87	96.77	90.32	100.00	35.48
	62.96	96.30	88.89	92.59	81.48
	71.67	81.67	78.33	81.67	68.33
	22.22	88.89	100.00	55.56	62.96
	78.08	not home	not home	94.52	56.16
	81.54	96.92	96.92	75.38	30.77
	98.11	100.00	98.11	100.00	88.68
	85.87	95.65	100.00	82.61	90.22
	90.48	96.43	100.00	94.05	not home
AVERAGE	76.08	92.07	94.72	87.97	72.94
STD.DEV.	20.62	10.69	7.50	14.35	24.29

All apartments treated in this study are from the [redacted] operated by Gary Public Housing

Personal privacy information

Whitmire's Avert® (abamectin) efficacy studies - Purdue Urban and Industrial Entomology Research Program

AVERT®
aerosol form

ADDRESS	Pretreatment	TOTAL 1 wk	VISUAL 2 wk	COUNT 4 wk	DATA 8 wk	12 wk
[redacted]	68	41	19	20	33	not home
	105	16	8	20	1	35
	68	10	5	1	4	15
	92	13	22	25	77	refusal
	32	4	0	0	0	0
	61	15	2	2	1	4
	36	5	0	1	0	0
	85	1	0	0	0	0
	334	22	16	12	25	51
	24	0	0	0	0	0
	81	not home	0	0	0	0
	37	6	1	0	0	1
	44	4	1	1	1	0
	55	0	1	0	0	0
	34	2	0	not home	0	not home
AVERAGE	77.07	9.93	5.00	5.86	9.47	8.83
STD.DEV.	75.16	11.21	7.66	9.18	21.24	16.87

All apartments treated in this study are from the [redacted] operated by Gary Public Housing

Personal privacy information

Whitmire's Avert® (abamectin) efficacy studies - Purdue Urban and Industrial Entomology Research Program

AVERT®
aerosol form

ADDRESS	% REDUCTION IN VISUAL COUNTS				
	1 wk	2 wk	4 wk	8 wk	12 wk
[redacted]	39.71	72.06	70.59	51.47	not home
	84.76	92.38	80.95	99.05	66.67
	85.29	92.65	98.53	94.12	77.94
	85.87	76.09	72.83	16.30	refusal
	87.50	100.00	100.00	100.00	100.00
	75.41	96.72	96.72	98.36	93.44
	86.11	100.00	97.22	100.00	100.00
	98.82	100.00	100.00	100.00	100.00
	93.41	95.21	96.41	92.51	84.73
	100.00	100.00	100.00	100.00	100.00
	not home	100.00	100.00	100.00	100.00
	83.78	97.30	100.00	100.00	97.30
	90.91	97.73	97.73	97.73	100.00
	100.00	98.18	100.00	100.00	100.00
	94.12	100.00	not home	100.00	not home
AVERAGE	86.12	94.55	93.64	89.97	93.34
STD.DEV.	15.10	8.74	10.52	23.83	11.07

Personal privacy information

All apartments treated in this study are from the [redacted] operated by Gary Public Housing

Weight of Avert® cockroach bait applied in the 1988 Purdue Field Trials

WEIGHT OF AVERT DRY FORM

Address	ESTIMATED BY WEIGHING THE JAR WITH DUST			ACTUAL AMOUNT OF ABAMECTIN APPLIED
	before	after	weight applied	weight applied
[redacted]	243.5	200.4	43.1	21.6
	242.9	212.7	30.2	15.1
	242.6	195.0	47.6	23.8
	243.1	201.2	41.9	21.0
	242.9	198.1	44.8	22.4
	243.3	195.1	48.2	24.1
	243.2	198.6	44.6	22.3
	242.7	209.9	32.8	16.4
	243.3	210.1	33.2	16.6
	242.9	214.9	28.0	14.0
	243.5	196.7	46.8	23.4
	242.8	206.3	36.5	18.3
	242.6	192.9	49.7	24.9
	242.6	209.0	33.6	16.8
	243.3	224.4	18.9	9.5
	243.5	203.4	40.1	20.1
AVERAGE			38.75	19.38
STD. DEV.			8.70	4.35
MINIMUM			18.9	9.5
MAXIMUM			49.7	24.9

Weights expressed as g of formulation mg of abamectin

Personal privacy information

Weight of Avert® cockroach bait applied in the 1988 Purdue Field Trials

WEIGHT OF AVERT AEROSOL

Address	*Weight of first can* Before	After	*weight of second can* Before	After	total weight applied	weight of abamectin
[redacted]	579.0	179.9			399.1	39.9
	577.0	270.6	547.7	218.1	636.0	63.6
	563.6	169.3	578.2	182.4	790.1	79.0
	586.3	155.8	579.5	191.5	818.5	81.9
	579.8	383.6	579.0	387.6	387.6	38.8
	577.1	252.9	578.7	319.6	583.3	58.3
	579.8	250.3	574.4	302.4	601.5	60.2
	582.0	279.6	572.7	272.2	602.9	60.3
	577.9	215.1	578.7	315.5	626.0	62.6
	580.5	379.9	577.0	399.1	378.5	37.9
	578.0	324.7	584.1	173.8	663.6	66.4
	569.5	213.7	580.7	212.6	723.9	72.4
	578.7	337.4	574.8	465.8	350.3	35.0
	578.4	440.6	580.9	384.9	333.8	33.4
	578.3	419.4	577.5	486.1	250.3	25.0

AVERAGE	543.03	54.30
STD. DEV.	178.66	17.87

MINIMUM	250.3	25.0
MAXIMUM	818.5	81.9

Weights expressed as g of formulation mg of abamectin

Personal privacy information

END